Evaluation of Some Proximal Sensing Methods for Mapping Soils in Urbanized Terrain, Detroit, Michigan

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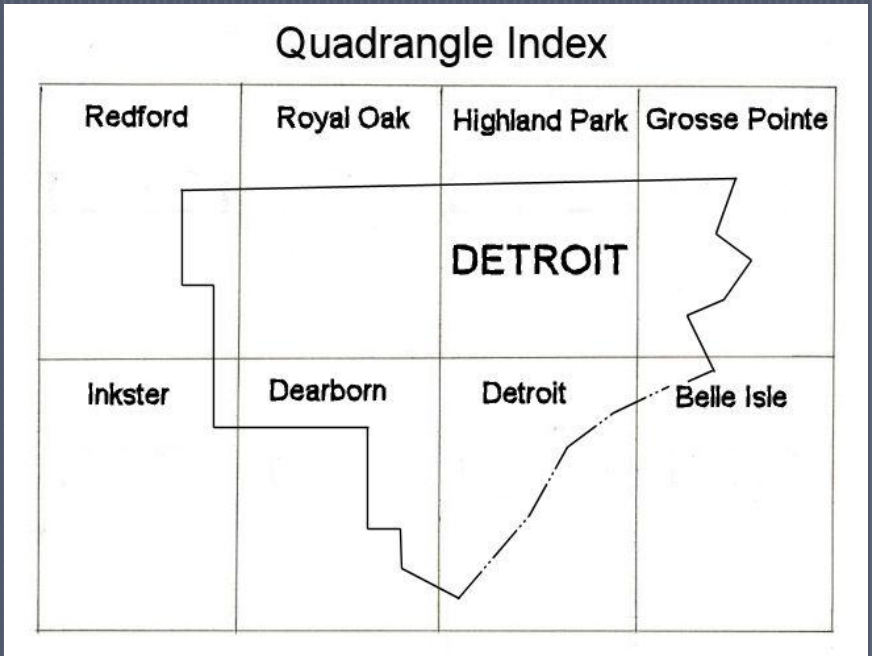
Background

- U. S. Geological Survey – EDMAP program
- NRCS Update of Wayne County (Detroit) Soil Survey of 1977 (Joe Calus - MLRA 12-FLI)

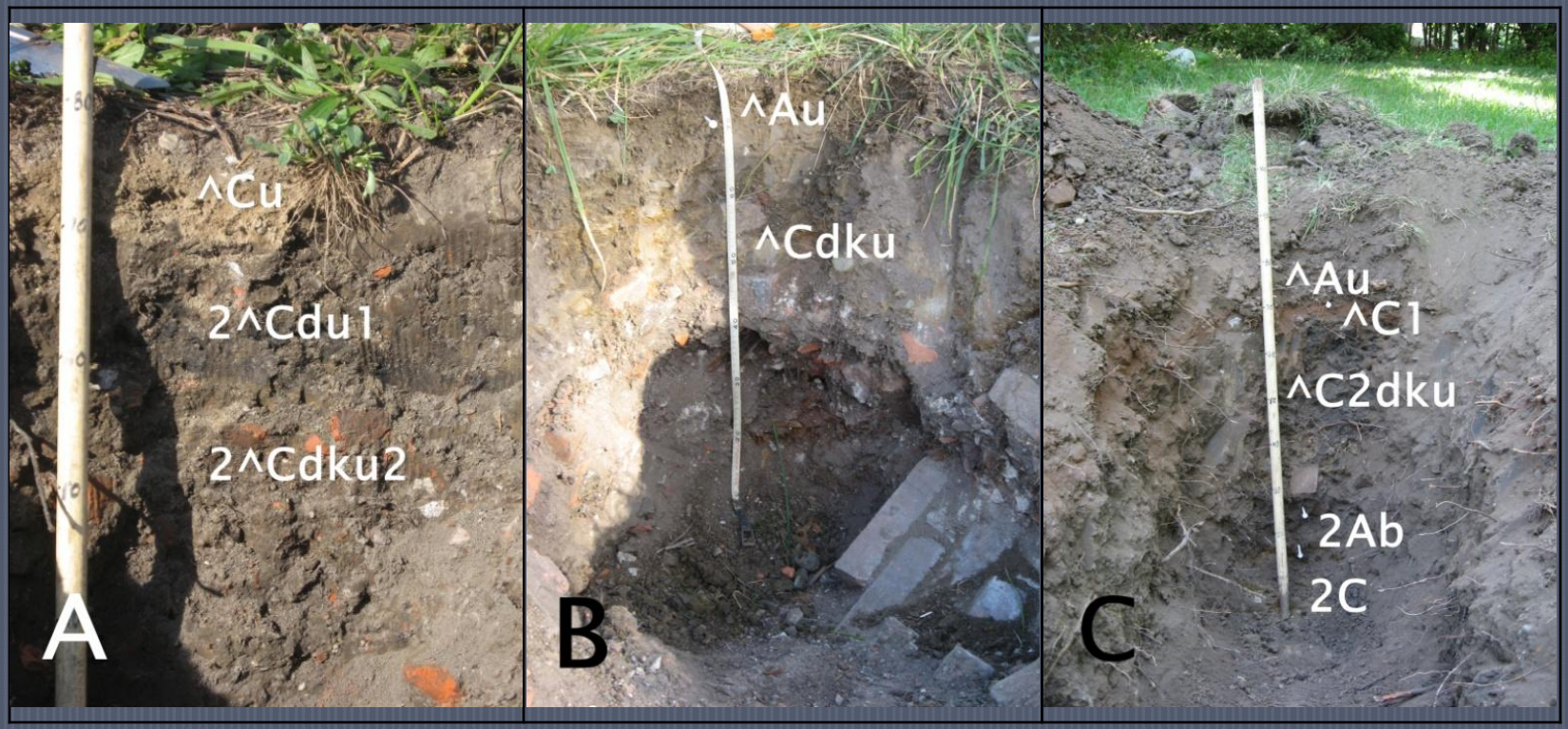


Problems

- Traditional soil auger approach (morphostratigraphic)
  - Excessive artifact content (50-95% auger refusals)
  - Spatial variability
  - Large number of sites

Excessive artifact content

Demolition site soils



Objective

- Find the "Magic Wand"
- Compare field probe data against lab data and ground truth (soil auger)

Approach

- Proximal sensing methods
  - Magnetic susceptibility
  - Electrical conductivity
  - Measured pH
  - Penetrability

Goals

- Distinguish natural vs. anthropogenic soils
- Distinguish amongst anthropogenic soil types

Field Equipment

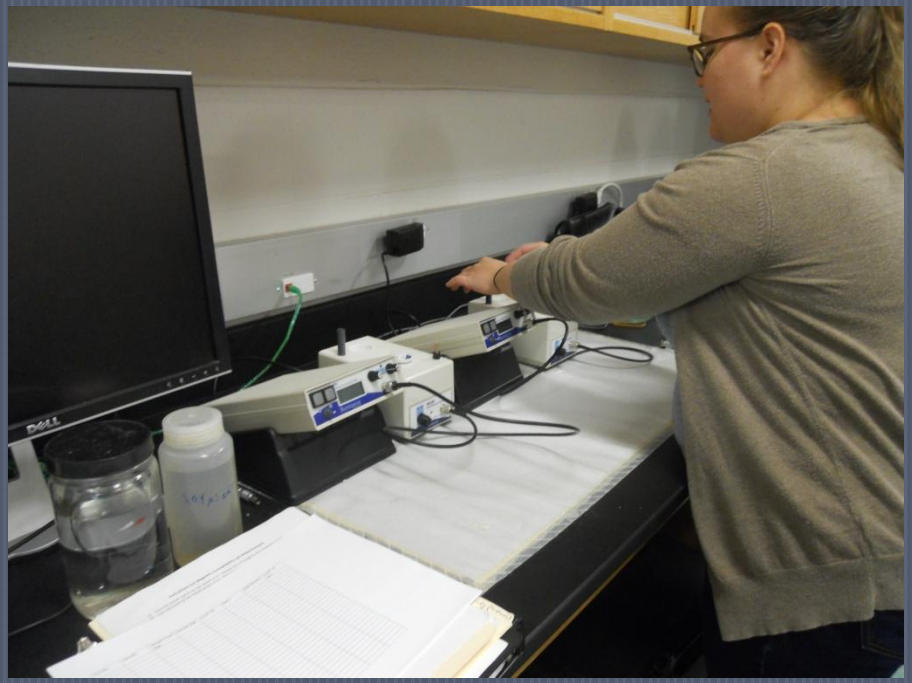
- AquaTerr EC-350 Salinity Meter
- Bartington MS2D surface scanner
- Dickey-john cone penetrometer
- Garrett ACE350 metal detector

Field Probes

Lab Equipment

- Mettler Toledo S230 EC meter
- Bartington MS2B lab sensor
- Mettler Toledo FEP20 pH meter

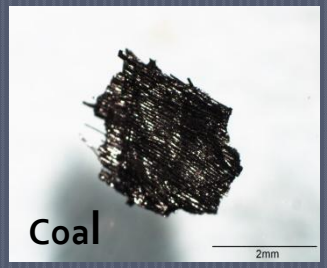

Nitrile Exam Gloves

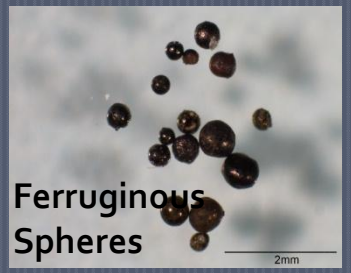

DELL

Microartifacts

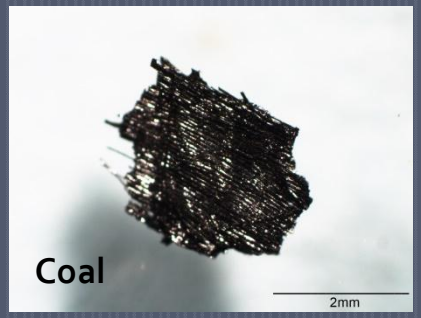
- Macroartifact = objects > 2 mm in size manufactured, modified or transported
- Microartifact = 0.25 – 2.0 mm
- Microparticles ≤ 0.25 mm

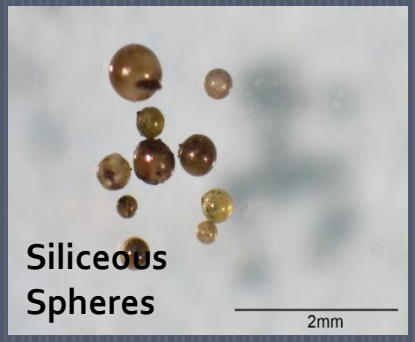
Microartifacts – Residential Demolition



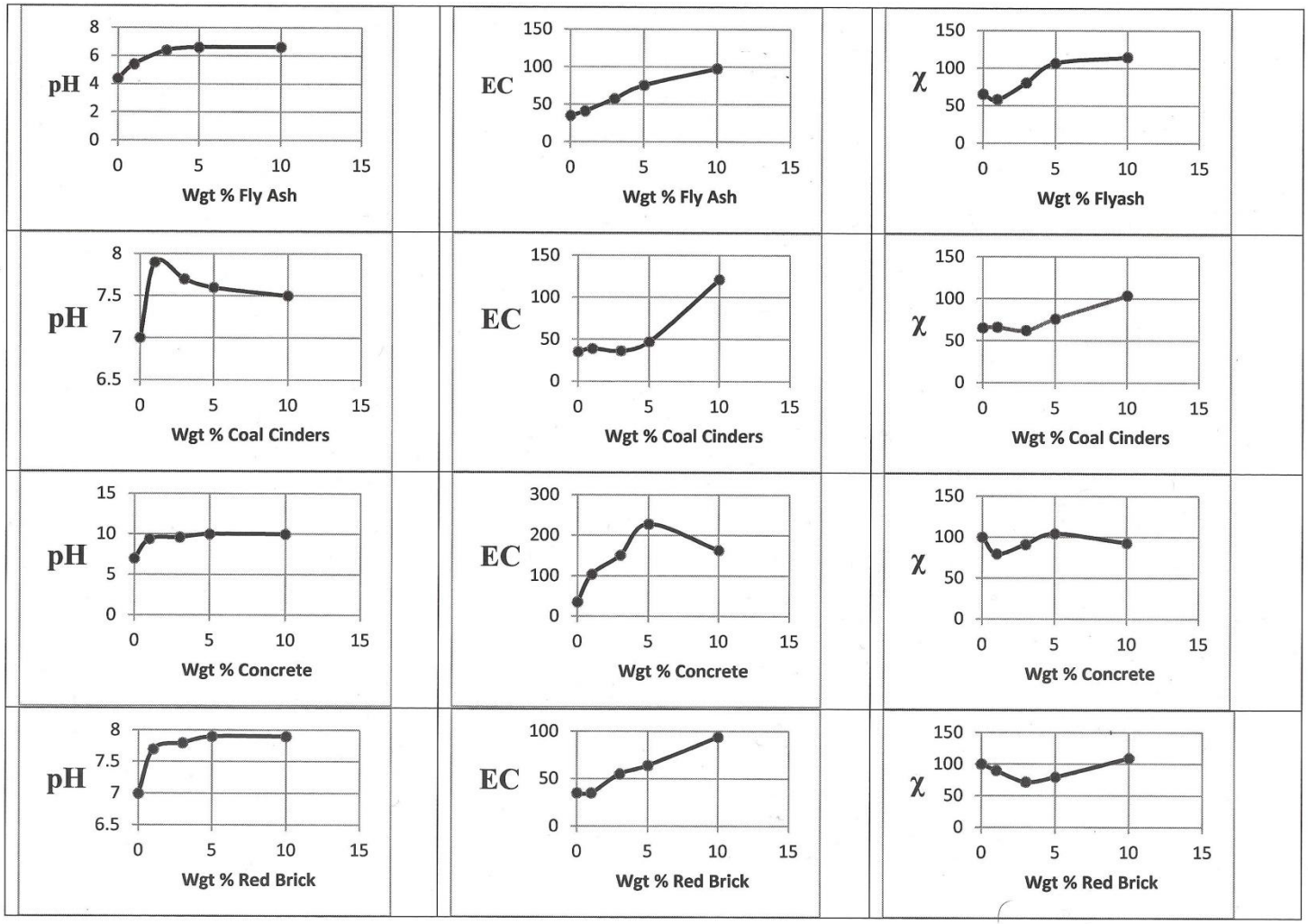


Microartifacts - Industrial





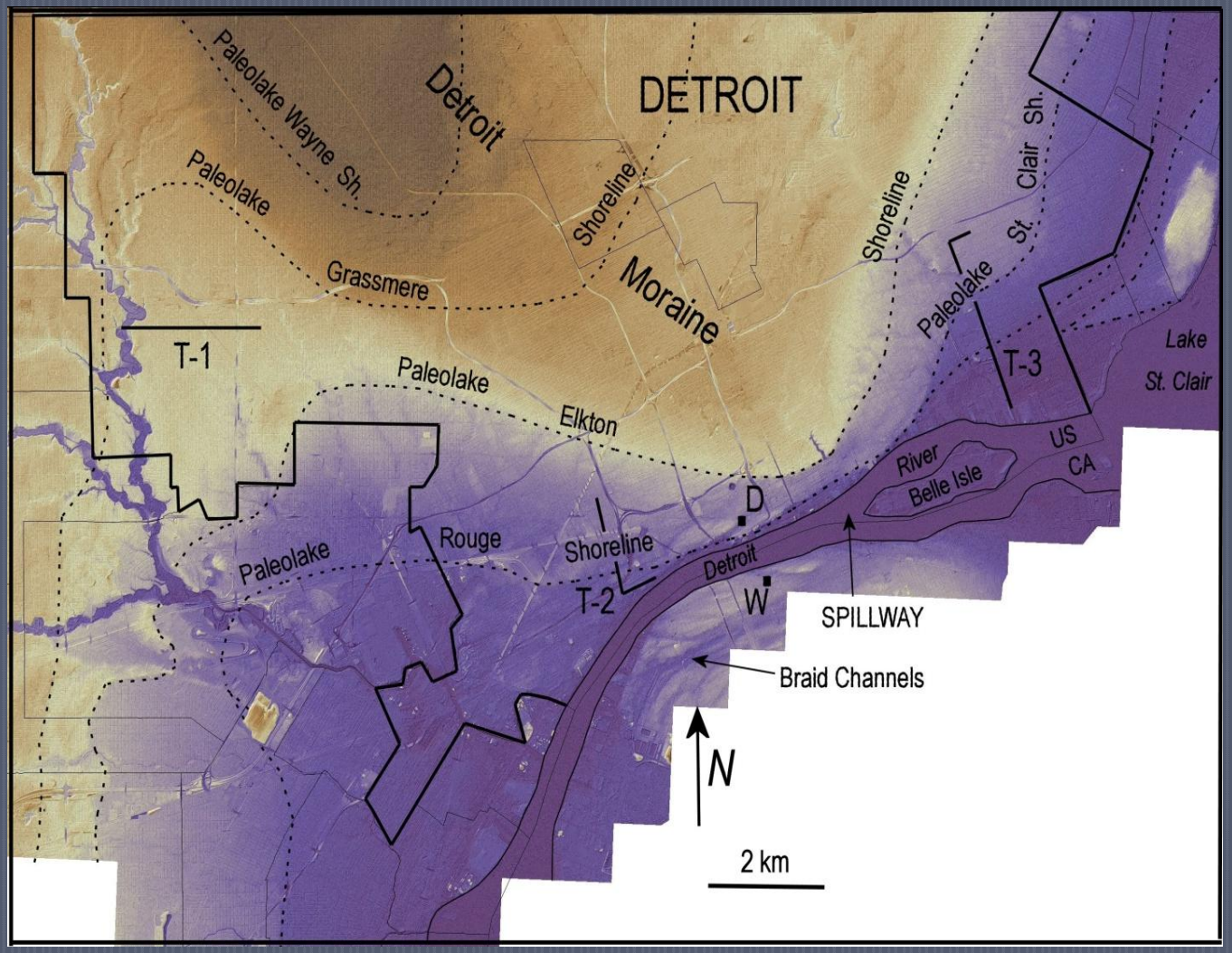
Effect of Microartifacts



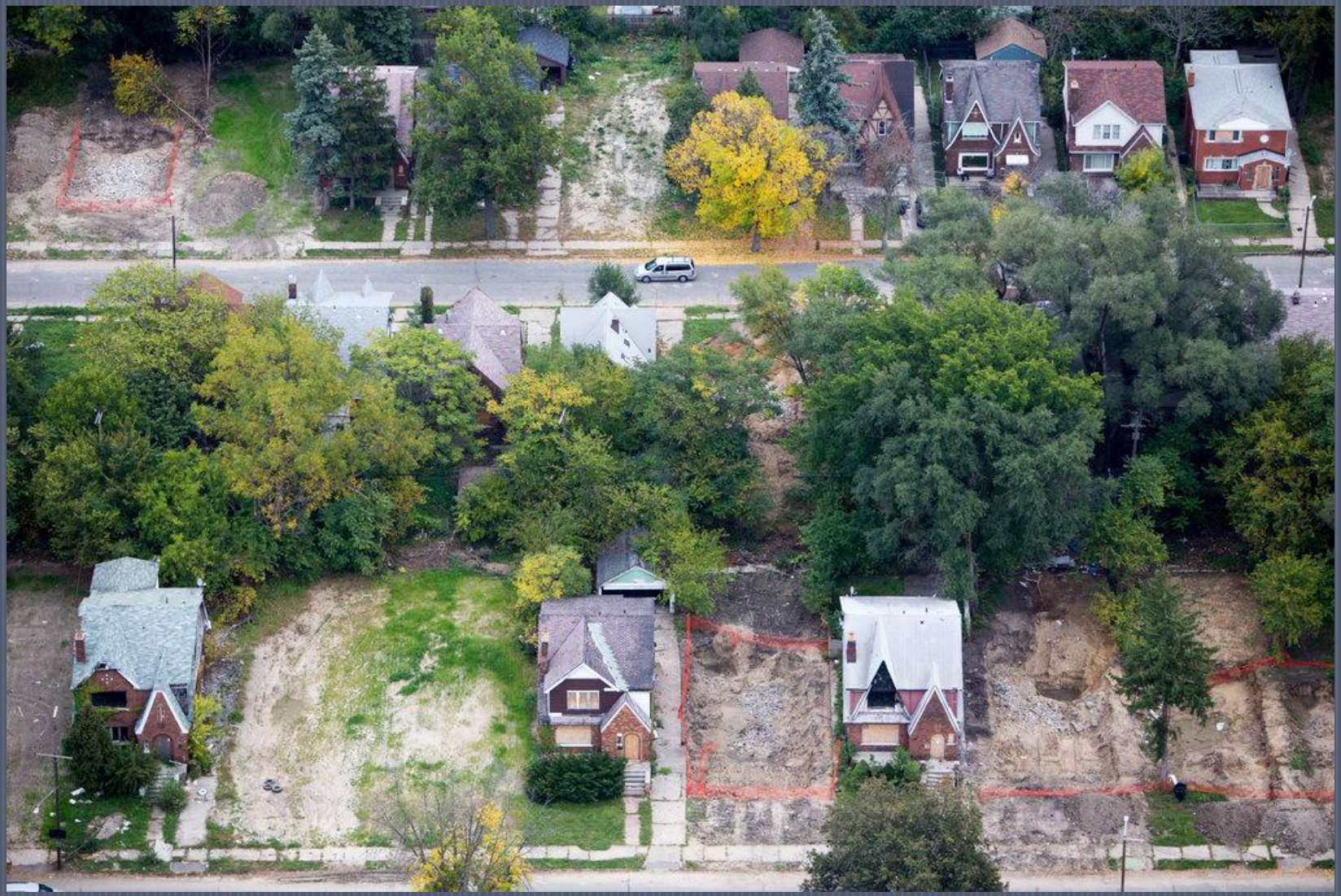
This study

- Transects across different land use types (Parkland, Residential demolition and undemolished, Industrial)
- Order 1 (1:1,800) mapping vacant land
- Order 2 (1:24,000) mapping of Detroit

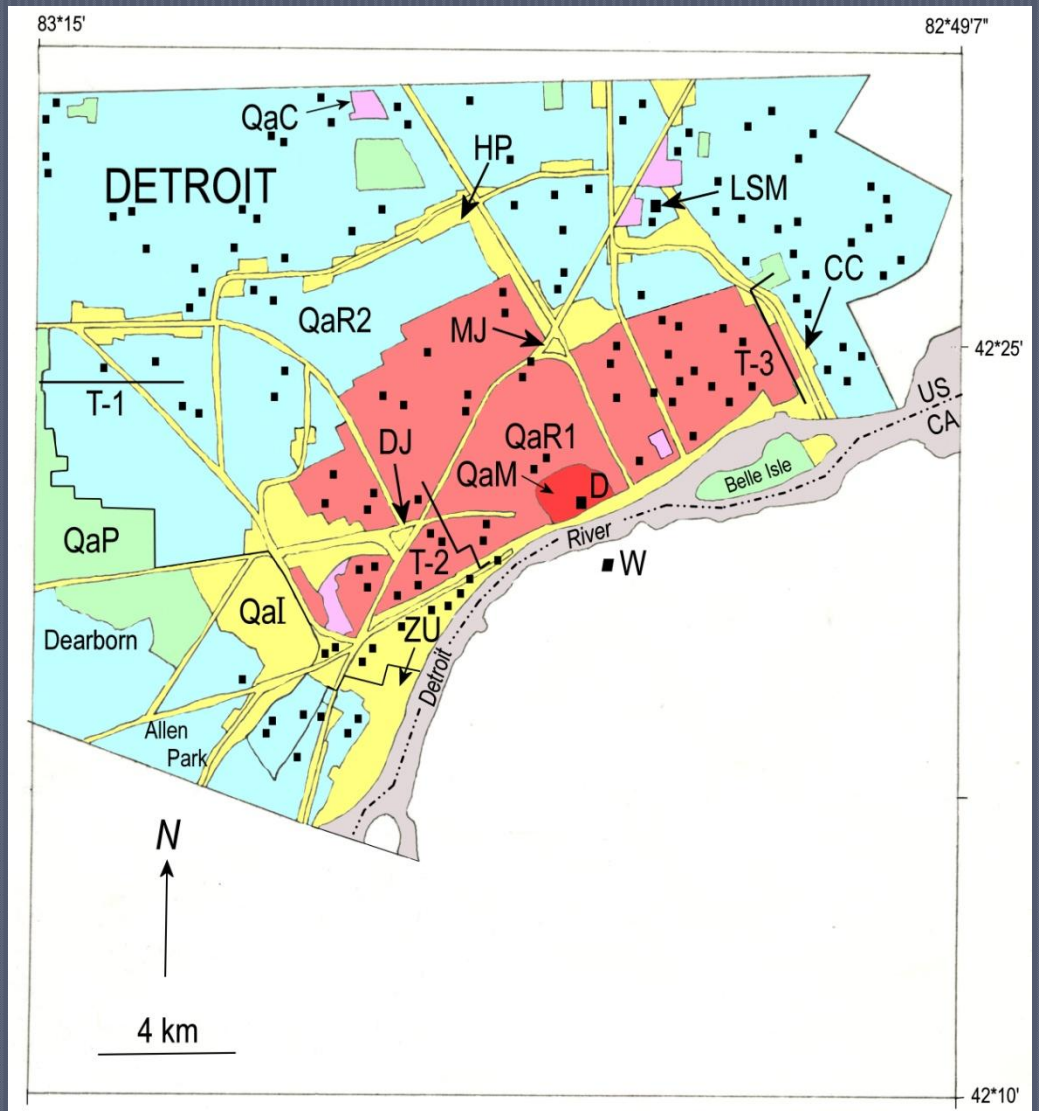
Geologic setting



Geocultural Setting



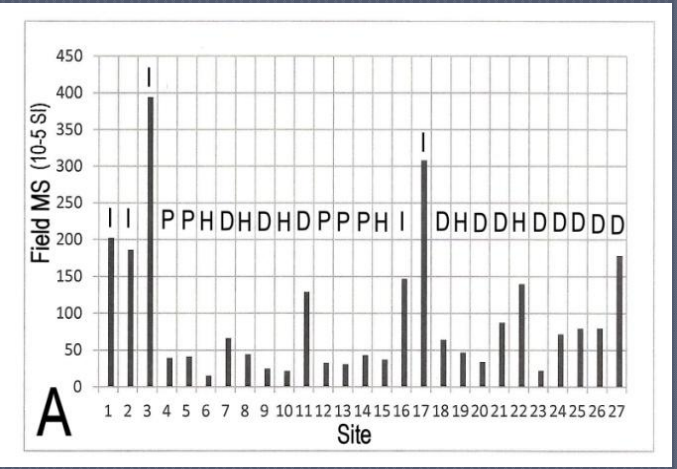
Anthropogenic Surficial Geologic Map

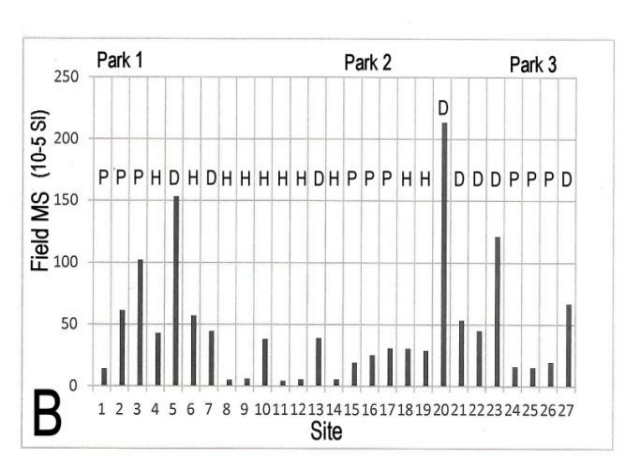


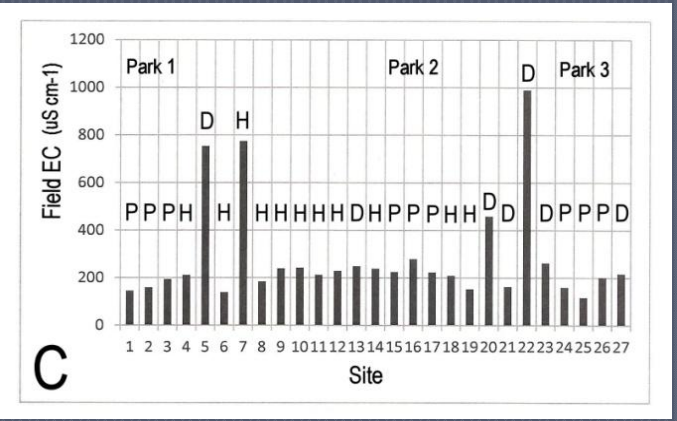
EXPLANATION

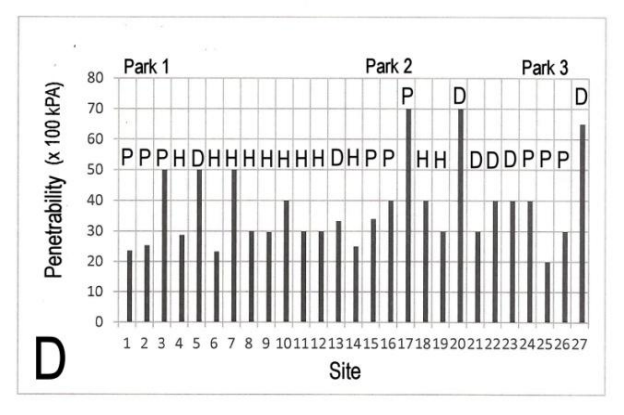
Anthropogenic Surficial Geologic Unit			
Map Symbol		**Urban Land Use Type**	**Zone**
	QaP	Park	
	QaR2	Residential	Zone 2
	QaR1		Zone 1
	QaM	Manufactured	
	QaI	Industrial	
	QaC	Cemetery	

Transect Studies





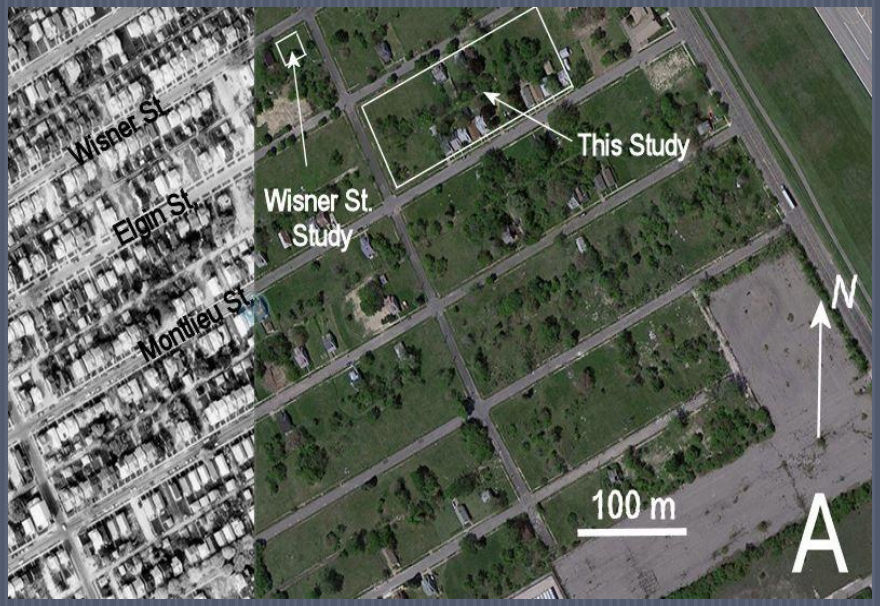


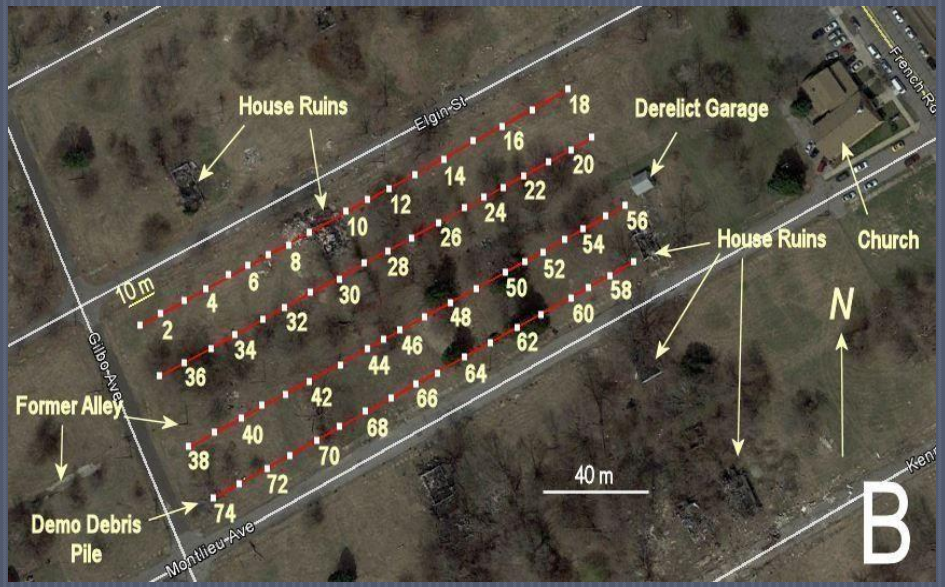


Transects - summary

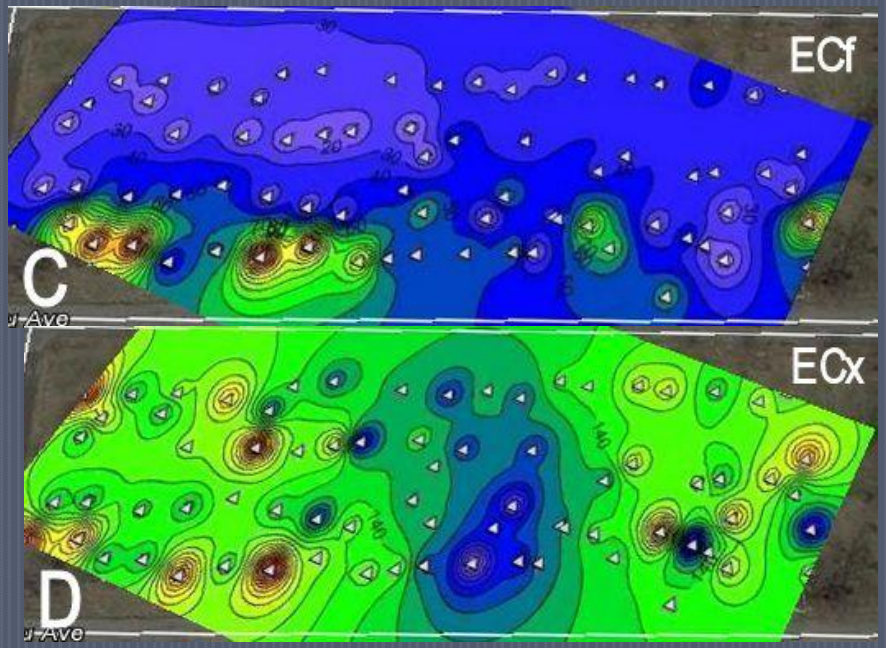
Parameter	Natural Soils	Anthropogenic Soils
pH	< 7.0	> 7.0
EC	< 110 µS cm-1	> 110 µS cm-1
MS	< 150 10-8 m3 kg-1	> 150 10-8 m3 kg-1
Penetrability	< 3400 kPa	> 3400 kPa

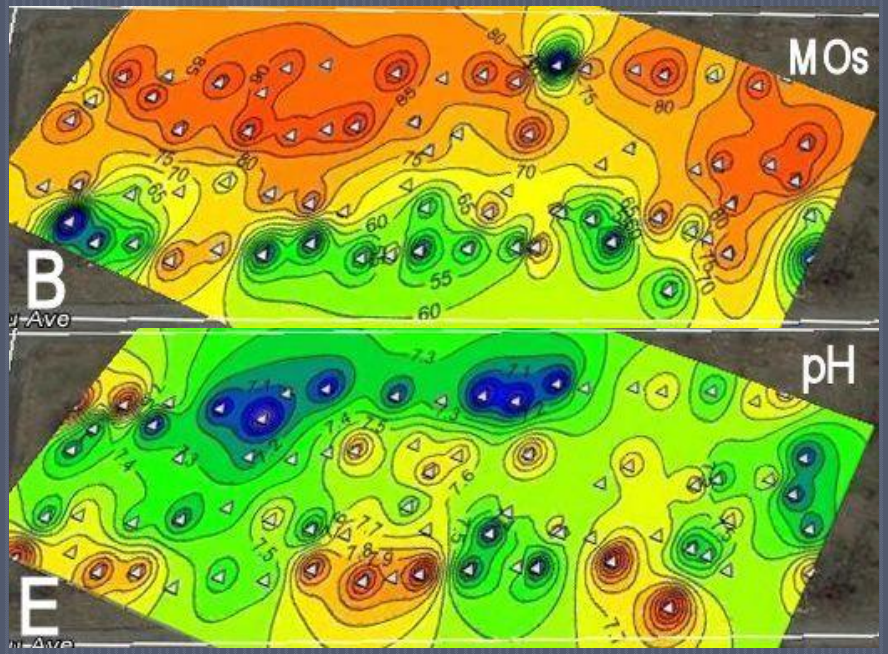
Order 1 Survey

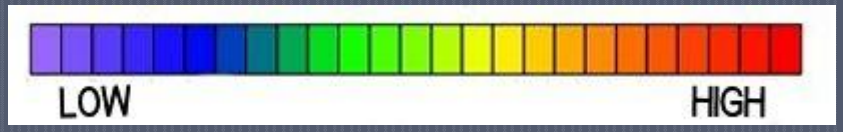




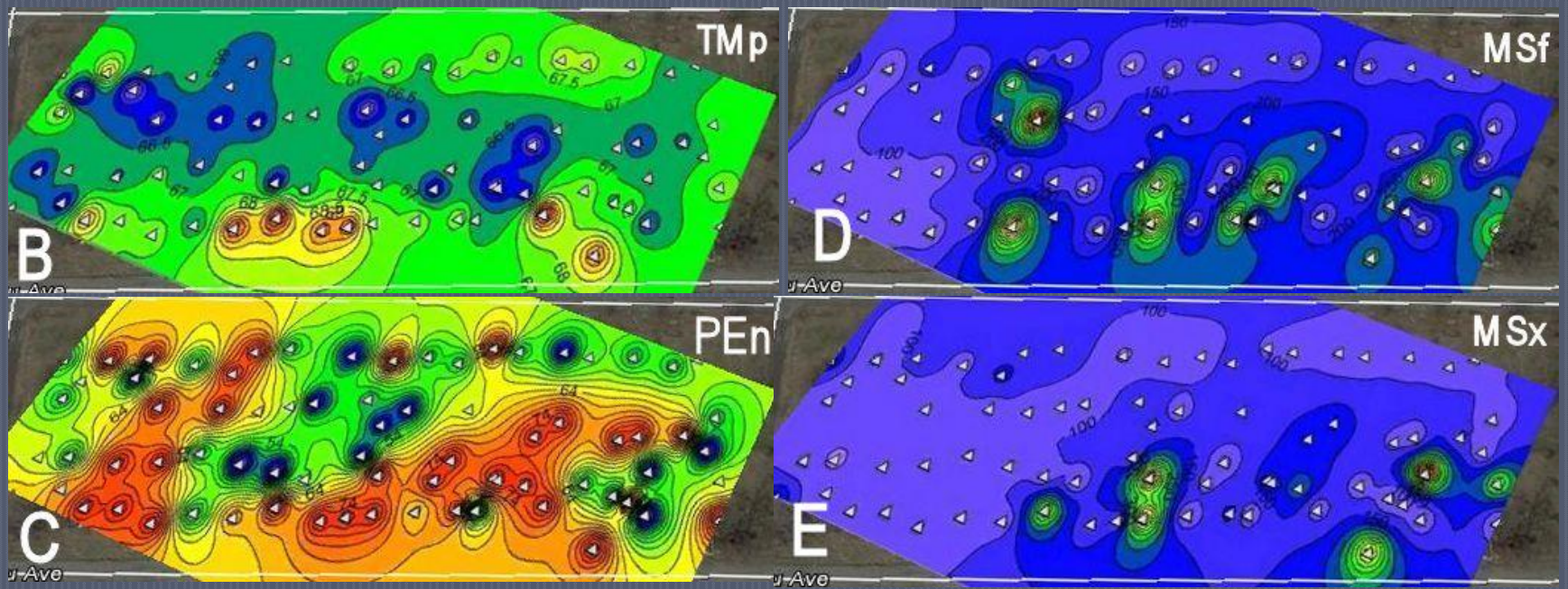
Order 1 Survey



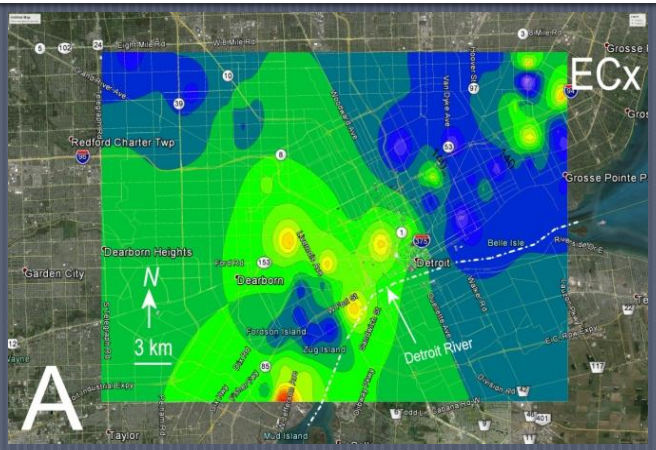


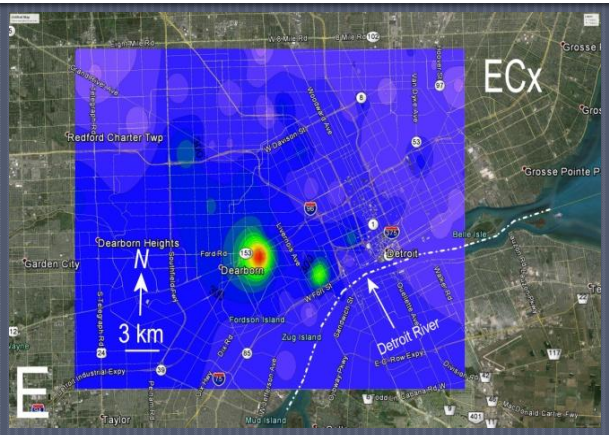


Order 1 Survey

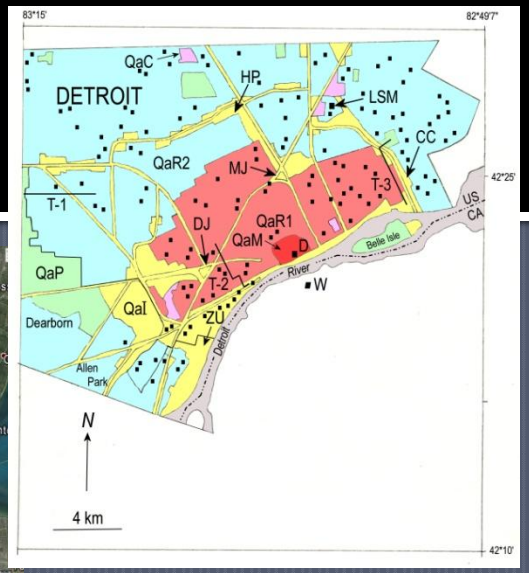


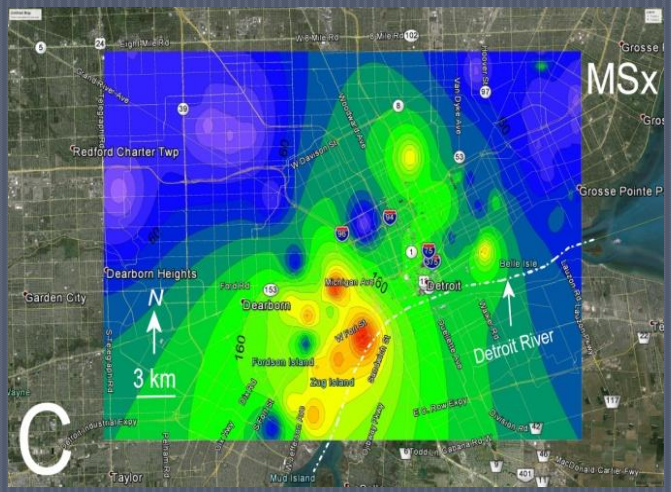
Order 2 Survey

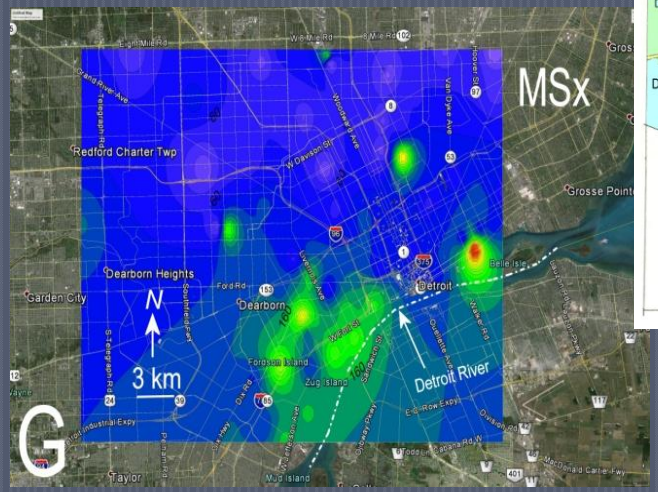




Order 2 Survey







Anthropogenic Map Index

pH	Score	ECx	Score	MSx	Score	Pen	Score
≤ 7.0	1.0	0 - 140	1.0	0 - 50	1.0	0 - 20	1.0
> 7.0	2.0	141 – 210	2.0	51 – 100	2.0	21 - 40	2.0
		211 – 280	3.0	101 – 150	3.0	41 - 60	3.0
		281 – 350	4.0	151 – 200	4.0	61 - 80	4.0
		> 350	5.0	201 – 250	5.0		
				251 – 300	6.0		
				> 300	7.0		

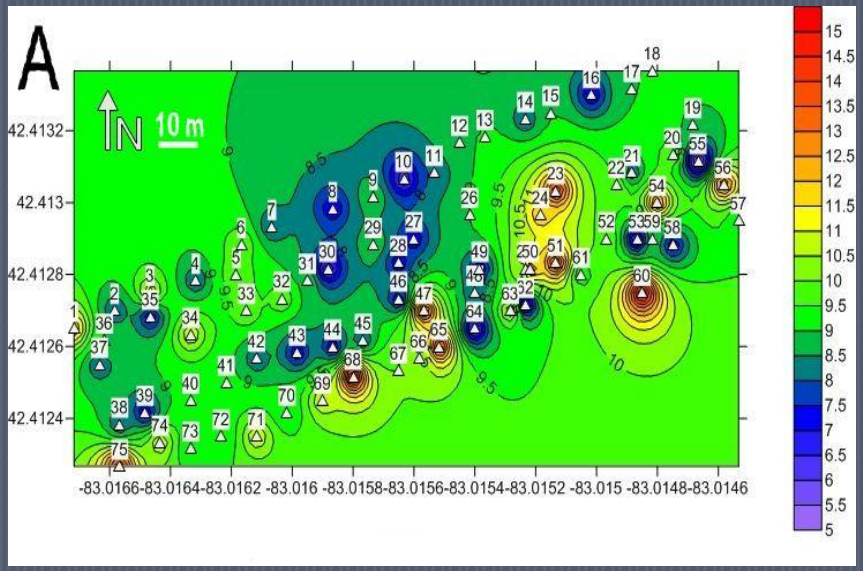
Anthropogenic Map Index

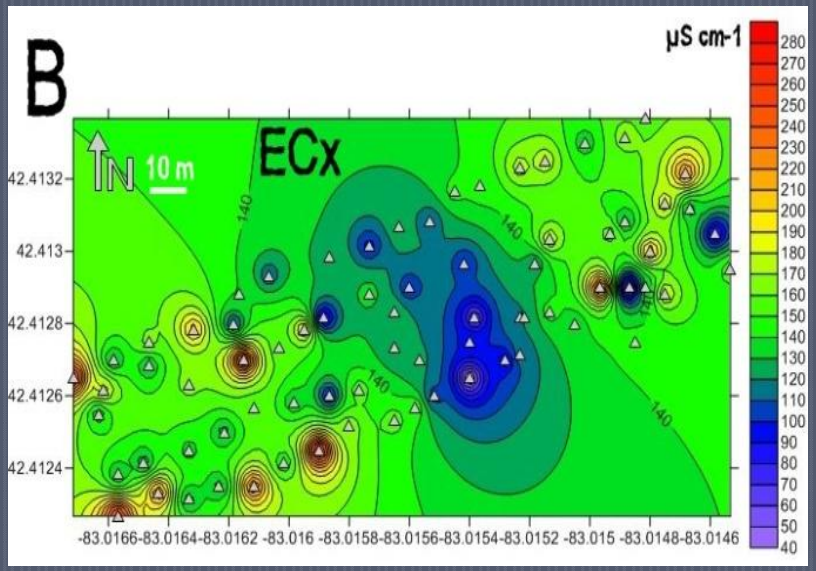
- AMI = ApH + Aec + Ams + Apen
- Native AMI = 4.0

Transects - AMI

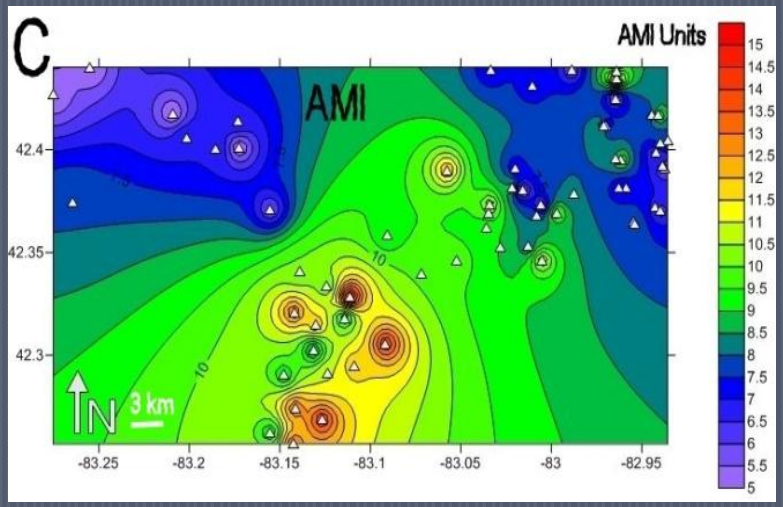
- AMI = I > D > U > P

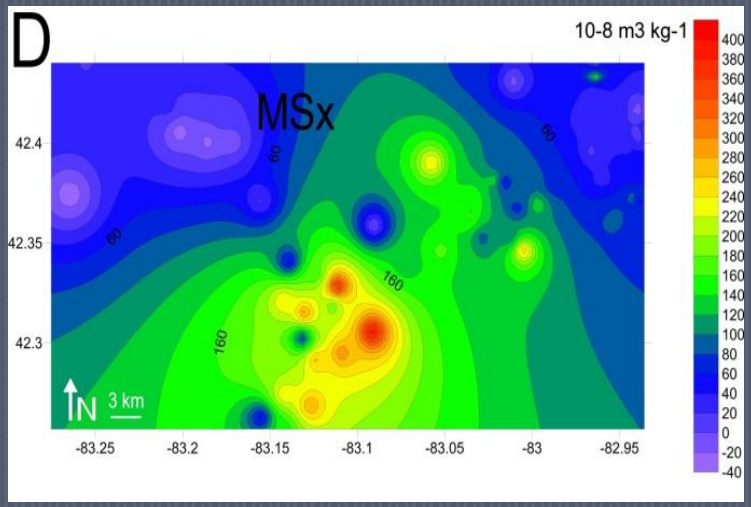
Order 1 Survey





Order 2 Survey





Wayne County (Detroit) updated survey: Outcomes

Lidar-assisted mapping is more accurate

Wayne County updated survey- Outcomes

- Urban soil maps are similar to land use maps
  (Parkland, Cemeteries, Residential, Industrial)

- Urban soil maps are a mosaic of:
  - Native Soil Series
  - Native Soil Series-Urban Land Complexes
  - Urban Land
  - Manufactured Land

Urban Land Component

- Modified preexisting soil (HAM)
- Scalpic soils – Anthropic phases of native soil series
- HTM (< 50 cm thick) - Anthropic phases of native soil series
- HTM (≥ 50 cm thick) – Anthropogenic series

Conclusions

- Tall grass interfered with surface scanners
- Artifacts interfered with pointed surface probes
- Field probes useful for Order 1 surveying
- Lab-based EC and MS yielded better results overall

Conclusions (cont.)

- Native Soil Series vs. Anthropogenic Soils Distinguishable
- Lab EC and MS more useful than field probes for Order 2 surveying
- EC (Building Material Wastes); MS (CCPs)
- MS distinguished Ashifactic soils

Publications

- http://clas.wayne.edu/jhoward
- jhoward@wayne.edu

The End